the air descends most decidedly from the upper layer. The anticyclone is now arrived at the process of dissolution.

K. CONCLUSION.

(26) The literature of the past 10 years [1883–1892] contains numerous expressions of opinion that are opposed to the laws of atmospheric motion; we may infer that the readers have thereby been led into error.

Too seldom do the mathematicians describe the process that they propose to submit to calculation. The whole presentation of the subject under computation may be erroneous or at least imperfect. The reader is not always able to determine to what extent the results of the computation have practical applications. For instance, Ferrel has not especially, in fact scarcely at all, considered the fact that the upper and lower strata of the atmosphere accomplish an equilibration of their moments of inertia by reason of a continuous steady mixture of their masses steadily as well as periodically renewed.

Again, the result that the belts of high pressure that inclose the hot zones ought to occur in the neighborhood of latitude 30° arises from an arbitrary assumption as to the magnitude of the total moment of rotation of the whole atmosphere, that is made even before the beginning of his analysis.

It is to be considered that the transportation of a kilo gram of air from the region of the pole to that of the equator or conversely, assuming the velocity of the wind to be zero at the beginning and the end of the transfer, expends an amount of work or absorbs an amount of work equal to about 20,000 kilogram-meters; so that the air coming from the equator transfers its kinetic energy or its moment of rotation to the air flowing in the opposite direction, either by direct processes of mixture of masses, or by means of friction on the rough ground in the cyclones and anticyclones, and therefore by the tension from west to east arising from the reaction between the ground and the air. In Ferrel's theories the very important processes of mixture of masses and the interchange of moments of rotation are scarcely mentioned, and therefore Ferrel's theoretical deductions give such large wind velocities and such slight values of the atmospheric pressure at the poles.

The solution of problems in dynamic meteorology are still always merely partial solutions that are only applicable between definite limits and under special assumptions. Therefore the numerical values thus obtained should not be considered, either by the mathematicians or the reviewers, as "refined gold" since thereby the theory would be brought into discredit.

Empiricists are inclined to reject not only the recognized imperfect numerical results of any theory, but also the good ideas on which these are based.

Hitherto theory has dealt too little with numerical results; we have been satisfied with the deduction of formulæ and therefore have not learned the useful applications of theory so quickly as would have been attained by more frequent execution of numerical calculations. In general, meteorologists themselves do too little observing. They know only so much of the weather processes as the observers communicate and important details remain unrecognized. No clear connected view of the weather processes can be obtained in this way.

The details of the theory of vortex motions, so far as they have been thoroughly developed in mechanics for the construction of turbines and centrifugal pumps and blowers, are too little known to meteorologists. At the present time we frequently find in meteorology efforts to establish new theoretical relations that have already been expounded with perfect clearness in practical mechanics.

Again, the theory of the processes of suction and obstruction ("Stau- und Sauge-Vorgänge") are not sufficiently studied by meteorologists and physicists, nor the conditions, circumstances, and extent to which work is performed or prevented in the atmosphere.

From the above exposition it follows that the mechanics of cyclones and anticyclones stands in close dependence on the work of the late eminent mathematician, William Ferrel; but can now be best furthered by simultaneous thorough consideration of the processes in space (viz, geographic) and by personal observation of all the details of the weather phenomena as found by studying the important synoptic weather charts and telegraphic weather reports.

Personal studies of this kind are, however, prevented by want of time and the modern system of the subdivision of work. Especially does the latter make it difficult for a single person to attain a general oversight of the whole subject. A subdivision of work is indeed demanded in the interests of a successful service in every meteorological institution; however, it should not be pushed so far that a meteorologist is prevented from the execution of personal observations or is robbed of the time needed to enable him to become well grounded in theoretical researches.

At the present time the development of the science of meteorology is directed too strenuously toward the subdivision of labor. We imagine that by the increase of ordinary observational data we may gain a general oversight of the subject. In reality, the labor applied to ordinary statistics and the conduct of the general service is thereby so greatly increased that there is no time or thought left for the practice of independent higher studies. One's interest is too much diverted from the consideration of the weather phenomena as a whole, and also from important details, such as the observation of the clouds and the method of formation of falling rain.

These defects, due to the unavoidable necessity of the subdivision of labor, are only to be overcome by the freest personal interchange of views, in order that the labors of many assistants may be made most profitable and productive by practically skillful, well-directed, and liberal-minded administration.

REFERENCES.

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"Ueber den Begriff Reibung und Bewegungsgrösse (Kraft) bei fliessenden, schwingenden und gleitenden Massen," Verhdlg. d. Vereins z. Beförd. d. Gewerbefleisses, Berlin, Jhrg. 1890, p. 231–252.
(2) **Ferrel, Wm.** Meteorological researches for the use of the Coast Pilot. Part 1: On the Mechanics and general motions of the atmosphere. Washington. 1877. p. 42, par. 38. f°. (U. S. Coast survey. [Publication])
Sprung, A. Lehrbuch der Meteorologie. Hamburg, 1885. p. 202.
(3) **Möller, Max.** Das räumliche Wirken und Wesen der Elektrizität und des Magnetismus. Mauz & Lange, Hannover, 1892. illus.

THE HALOS OF NOVEMBER 1–2, 1913.

[Translated from Annuaire, Soc. météorologique de France, mai, 1914.]

Mr. Louis Besson offered a communication [May 5, 1914] on the oblique arcs of the anthelion. This phenomenon, one of the rarest connected with unusual halos, has been seen two days in succession in the United States, November 1 and 2, 1913.

The observations made on that occasion will soon be published in the United States Monthly Weather Review of the Weather Bureau. Unfortunately, they do not sensibly increase our knowledge of the oblique arcs of the anthelion, whose mode of production remains obscure. By examining closely what has been stated by Bravais, Mr. Besson has determined that he can account for only the short arcs, deviating a little from the anthelion upward, but not at all for those which extend as far as the region of the sun. It is very desirable that at their next appearance the oblique arcs of the anthelion be observed with more precision and more detail than previously. A photograph, especially in the case of short arcs, will be the most instructive document. If the arcs are long, it will be proper to give attention to the following points:

Are these true arcs of the circle, or, in other words, is their curve uniform and, in this case, what is their radius of curvature?

What is the angle between them at their point of crossing over the anthelion?

At what distance from the zenith do they pass?

At what point of the sky do they recross?

Is this exactly on the sun?

It is indispensable to note the exact time when the observation was made, for the character of the phenomena must vary with the height of the sun.

Mr. Lemoine thinks that it would be advantageous, in the study of halos, not to confine ourselves to observation, but to consider also methods of experimentation. With the present resources of our laboratories we can reasonably produce artificially various crystalline forms of ice and study their optical properties.

Mr. Besson says that he shares entirely the opinion of Mr. Lemoine, and that he has never neglected an opportunity to point out to physicists and to laboratory crystalographers the experimental study of the crystallization of ice as an interesting and certainly profitable study, but up to the present time he has not succeeded in interesting any one who possessed the necessary equipment.

On the other hand, he took occasion to remark that, in the study of halos, observation and experiment each has its own domain—the first alone can make known to us the natural phenomena to be explained; the second is for the purpose of teaching us the various possible forms of ice crystals and showing us which can best account for the optical appearances.

Mr. Goutereau recalls that Mr. Besson, in his researches on halos, had recourse to experimentation to determine the orientation that ice crystals take in falling.

HALOS IN FEBRUARY, 1914.

The following report by Daingerfield of the halo seen on February 6, 1914, at Pueblo, Colo., and again the reports by Flora, Holcomb, and Judy of the halo seen on February 24, 1914, in Kansas, are reprinted from the respective Monthly Section Summaries by request of Prof. C. F. Talman, as referring to rarer forms of halos and of interest to students of halo phenomena.—[C. A.]

REMARKABLE HALO AT PUEBLO, COLO., FEBRUARY 6, 1914.

Mr. L. H. Daingerfield, Local Forecaster, Pueblo, Colo., sends a report and drawings of a remarkable solar halo observed at that place between sunrise and 9 or 9:30 a. m., February 6, 1914, by Mr. W. F. Doertenbach, Mr. J. K. Sweeny, and himself. The phenomenon included a complete and brilliantly colored halo of 22° radius around the sun, part of a fainter halo of 46° radius, a complete parhelic circle, a brilliant circumzenithal arc, parhelia of 22° and 46°, and a sun-pillar forming a cross with the parhelic circle. Fragments of another heliocentric halo, described as about 66° from the sun, with paranthelia at their point of intersection with the parhelic circle, are also mentioned in the report. As these arcs do not agree in position with any known form of halo and as the report states that "the color may have been altogether white," it seems possible that these were fragments of the halo of Hevelius (the 90° halo).

One of the drawings (none of which are reproduced) sent by Mr. Daingerfield shows the circumzenithal arc forming a complete circle, also an arc of a halo of about 22° radius, prismatically colored, surrounding the point opposite the sun in azimuth, as well as certain other features that do not correspond with any forms of halo heretofore recorded. It also shows four paranthelia, two at the point of intersection of the small halo opposite the sun with the parhelic circle, and two on the parhelic circle about 60° from the antisolar point. This drawing appears to be a composite of the observations of several persons.—[C. F. T.]

UNUSUAL SOLAR HALOS SEEN IN KANSAS ON FEBRUARY 24, 1914.

Solar halos of unusual appearance were observed in eastern, northern, and central Kansas on February 24, 1914, from 9 a. m. to 10 a. m., and sun dogs (parhelia) of considerably more than usual brilliancy were seen from

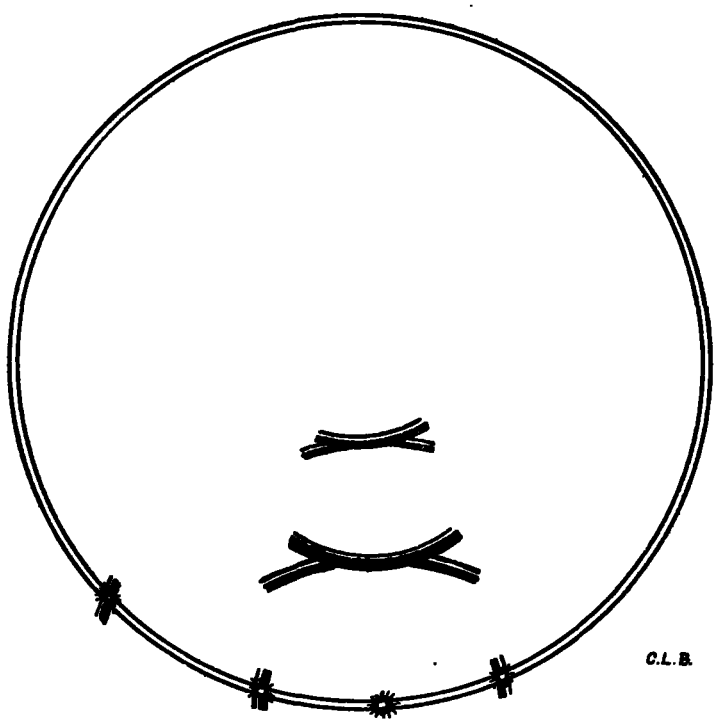

FIG. 1.—Solar halos seen at Topeka, Kans., February 24, 1914, between 9:30 and 10 a. m. (90th meridian time).

4 to 5:30 p. m. of the same day over the northern and central portions of the State.

From the meager descriptions received it is believed that halos reported at Hoxie, Kans., Beloit, Wis., Minneapolis, Minn., and Council Grove, Kans., were similar in